CIA/PB 131632-51

UNCLASSIFIED- SOVIET BLOC INTERNATIONAL GEOPHYSICAL YEAR INFORMATION

JANUARY 30 1959

PB - 51

52

PB 131632-51

SOVIET BLOC INTERNATIONAL GEOPHYSICAL YEAR INFORMATION

January 30, 1959

U. S. DEPARTMENT OF COMMERCE
Office of Technical Services
Washington 25, D. C.

Published Weekly
Subscription Price $12.00 for the Series

PLEASE NOTE

This report contains unevaluated information on Soviet Bloc International Geophysical Cooperation-1959 activities selected from foreign-language publications as indicated in parentheses. It is published as an aid to United States Government research.

INFORMATION ON SOVIET BLOC INTERNATIONAL GEOPHYSICAL COOPERATION

Table of Contents

I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Pravda Gives Details on the Soviet Space Rocket

The launching of the Soviet cosmic rocket on 2 January resulted in a great number of statements and piecemeal information in the subsequent days. A complete and comprehensive coverage of the flight and scientific experiments conducted are given in a two-page article appearing in the 12 January issue of Pravda, a complete translation of which follows.

A space rocket was successfully launched in the Soviet Union in the direction of the Moon on January 2, 1959. For the first time in the history of man, a device has been developed which not only attained but also exceeded the second cosmic velocity. The last stage of the rocket, weighing 1,472 kilograms (without fuel), flew near the Moon and became the first artificial planet of the solar system.

This event signifies a new stage in the conquest of outer space. A new celestial body was created by the constructive labor of the Soviet people; it overcame the Earth's gravity and is moving along an elliptical orbit around the Sun.

The development of a space rocket was a natural continuation of the work on intercontinental rockets and large artificial Earth satellites conducted in the Soviet Union. It will be recalled that Soviet Sputnik III weighed 1,327 kilograms. This work has made it possible to accumulate the necessary experience for developing large space craft.

The flight of the rocket in outer space has made it possible to carry out a whole range of major scientific experiments in investigating interplanetary space. For the first time, science realized the possibility of conducting a broad program of direct scientific measurements at such great distances from the Earth.

The launching of the space rocket is another new remarkable achievement for Soviet science and technology. For accomplishing this flight in space a multistage rocket, noted for high perfection of design and having powerful, highly efficient rocket engines, was built. Control of the flight of the space rocket during launching into a specified trajectory with great accuracy was effected by a special automatic system.

Unique scientific equipment and special radiometric systems were developed to carry out the program of scientific experiments. The total weight of the scientific and measuring instruments with the sources of power and the container, housed in the last stage of the space rocket, is 361.3 kilograms. Control of the flight path of the rocket in outer space was effected with the help of a set of radio engineering devices which made it possible reliably to determine the coordinates and velocity of the rocket at each moment of its movement.

The launching of the Soviet space rocket signifies man's entry into the era of interplanetary flights. The next stages along this path should be further investigations of outer space near the Sun, investigation of the planets of the solar system, and the flight of man to other planets.

The scientists, designers, engineers, technicians, workers, and testers, whose inspired constructive labor inscribed a new page in the annals of world science and technology, dedicated the launching of the space rocket to the 21st Congress of the CPSU.

All Soviet people are discussing the magnificent program of building Communism in our country, put forward in the theses of Comrade N. S. Khrushchev's report to the 21st Congress of the CPSU. Fulfillment of this program under the guidance of the Communist Party and the Soviet Government will ensure the still more rapid economic advance of our country and enable the Soviet people to scale new summits in all spheres of science and technology.

There is no doubt that in the next few years, we will witness new outstanding successes of our country in mastering outer space and discovering new secrets of nature for the good of the Soviet people and all progressive mankind.

The high appraisal, given by the Central Committee of the CPSU and the USSR Council of Ministers to the efforts of the scientists, engineers, technicians, and workers who created the multistage space rocket and launched it successfully in the direction of the Moon on 2 January 1959 inspires the personnel of scientific research institutes, design bureaus, plants, and testing organizations to work selflessly for the achievement of new successes in the mastery of outer space.

Flight of Space Rocket

The multistage space rocket was launched from the ground vertically. It was gradually made to veer away from the vertical line of flight by the progeam mechanism of the automatic control system. The rocket quickly gained speed. When the rocket's last stage had reached the final point of its acceleration, it had attained the speed required for further motion. The automatic control system of the last stage cut off the engine and separated the container housing the package of scientific instruments from the last stage. Both the container and the last stage, quite near to each other, entered the flight path and began to move toward the Moon.

To overcome the Earth's gravitational pull, the space rocket has to acquire a velocity not less than the second cosmic velocity. The second cosmic velocity, also known as the parabolic velocity, is 11.2 kilometers per second at ground level. It is critical in the sense that at lesser velocities, called elliptical, the body either becomes a satellite of the Earth, or, after reaching a ceiling, returns to Earth. At speeds greater (hyperbolic speeds), or equal to, the second cosmic velocity, a body can overcome the Earth's attraction and escape forever.

The Soviet space rocket had already exceeded the second cosmic velocity by the time the engine of the rocket's last stage was cut off. Its further motion, up to its approach to the Moon, is mainly influenced by the Earth's attraction. Consequently, according to the laws of celestial mechanics, the rocket's flight path, in relation to the center of the Earth, is very close to a hyperbola, for which the center of the Earth is one of its foci. The trajectory is most crooked near the Earth. It becomes straighter the further it gets away from the Earth. At great distances away, it is very close to a straight line.

When starting along the hyperbolic trajectory, the rocket moves very fast. But the further it gets away from the Earth, the less the speed of the rocket becomes. This is due to the effects of the Earth's attraction. Thus, at the altitude of 1,500 kilometers, the rocket's velocity in relation to the center of the Earth was slightly more than 10 kilometers per second. At an altitude of 100,000 kilometers, it was equal to about 3.5 kilometers per second.

The rate of rotation of a radius-vector connecting the center of the Earth with the rocket, diminishes, in accordance with Kepler's second law, in inverse proportion to the square of the distance away from the Earth's center. Whereas at the beginning of the flight, this velocity was about 0.07° per second, or more than 15 times greater than the angular velocity of the Earth's diurnal rotation, about an hour later, it was less than the Earth's angular velocity. When the rocket was nearing the Moon, the rate of rotation of its radius vector had decreased by a factor of more than 2,000 and was but one fifth of the angular velocity of the Moon's revolution around the Earth. The speed of the Moon's revolution is only 1/27 of the Earth's angular velocity.

These specific features of the rocket's flight along its trajectory determined the nature of its shifting in relation to the Earth's surface.

The shifting of the rocket projected on the Earth's surface in the course of time is depicted in the chart. While the speed at which the rocket's radius-vector turned was still great, in comparison with the speed of the Earth's rotation, this projection shifted eastward, gradually deviating to the south. Then, the projection began to shift, at first southwest, and 6 or 7 hours after the rocket launching, when the speed at which the radius-vector rotation had become very small, it shifted almost exactly west.

The rocket's movement among the constellations in the celestial sphere is depicted in the diagram. The motion was uneven -- fast at the beginning and very slow toward the end.

Approximately an hour after flight, the path of the rocket in the celestial sphere entered the constellation of Coma Berenices. Then the rocket went over into the constellation of Virgo, in which it drew close to the Moon. At 3 hours 57 minutes, Moscow time, on 3 January, when the rocket was in the constellation of Virgo, approximately in the middle of the triangle formed by the stars of Arcturus, Spica, and Alpha Librae, a special device installed on board the rocket created an artificial comet consisting of sodium vapors shining in the rays of the Sun. This comet could be observed from the Earth by optical means for several minutes. During its passage near the Moon, the rocket was in the celestial sphere between the stars of Spica and Alpha Librae.

The path of the rocket in the celestial sphere when it drew closer to the Moon was inclined approximately 50 degrees towards the Moon's path. Near the Moon the rocket moved in the celestial sphere approximately 5 times slower than the Moon.

The Moon, moving along its orbit around the Earth, approached the nearest point to the rocket from the right if viewed from the northern part of the Earth. The rocket drew to this point from above and from the right. During the period when they were closest, the rocket was above and slightly to the right of the Moon.

The time of flight of a rocket to the orbit of the Moon depends on the excess of the initial velocity of the rocket over the second cosmic velocity and will be all the smaller, the greater this excess is. The selection of the magnitude of the excess was made so that the passage of the rocket near the Moon could be observed by radio equipment located on the territory of the Soviet Union, in other countries of Europe, and also in Africa and in the greater part of Asia. The flight time of the space rocket to the Moon was 34 hours.

According to precise data, the distance between the rocket and the Moon when they were nearest to each other was approximately 5,000-6,000 km, i.e., approximately equal to 1.5 times the diameter of the Moon.

When the space rocket was within tens of thousands of kilometers of the Moon, the Moon's force of gravity began to exert a noticeable influence on the movement of the rocket. The action of the Moon's force of gravity led to a deviation in the direction of the rocket's movement and to a change in the magnitude of the velocity of its flight near the Moon. During the approach, the Moon was below the rocket, and, therefore, owing to the Moon's force of gravity, the direction of the rocket's flight deviated downward. The Moon's attraction also created a local increase in velocity. This increase reached its maximum in the area where the Moon and the rocket were nearest to each other.

After passing near the Moon, the space rocket continued to move further away from the Earth. Its speed, in relation to the center of the Earth, diminished, reaching an order of approximately 2 kilometers per second.

At distances of one million kilometers and more away from the Earth, the effects of the Earth's gravitational pull are so weak, that the rocket can be considered to be moving only under the influence of the Sun's attraction. Around 7 or 8 January, the Soviet space rocket entered an orbit of its own around the Sun. It became the Sun's satellite, the world's first artificial planet in the solar system.

Around 7-8 January, the velocity of the rocket, in relation to the center of the Earth, was directed roughly to the same side as that of the Earth in its revolution around the Sun. Since the Earth moves with a speed of 30 kilometers per second, and the speed of the rocket, in relation to the Earth, was 2 kilometers per second, the speed of the rocket's motion around the Sun as a planet was approximately 32 kilometers per second.

Precise data about the rocket's position, direction, and value of its velocity at great distances from the Earth enable us, according to the laws of celestial mechanics, to compute the movement of the space rocket as a planet of the solar system. The orbit has been computed without considering the perturbations that the planets and other bodies of the solar system might produce. The computed orbit is described by the following data:

The orbit's inclination to the Earth's orbit plane is about one degree, i.e., extremely small; the eccentricity of the artificial planet's orbit is 0.148, which is appreciably greater than the eccentricity of the Earth's orbit, which is 0.017; the minimum distance from the Sun is about 146 million kilometers, this is only a few million kilometers less than the distance between the Earth and the Sun, which averages 150 million kilometers; the maximum distance from the Sun will be about 197 million kilometers, at this point, the space rocket will be 47 million kilometers further away from the Sun than the Earth; the artificial planet's period of revolution around the Sun will be about 450 days, or approximately 15 months, and it will first reach the point closest to the Sun in the middle of this month, and the point, farthest away, in early September 1959.

It is interesting to note that along its orbit, the Soviet artificial planet will approach the orbit of Mars to within a distance of 15 million kilometers, i.e. approximately four times closer than the Earth's orbit.

The distance between the rocket and the Earth, in their movement around the Sun, will change. It will grow now greater, now smaller. The greatest distance between them may be between 300 to 350 million kilometers. During their revolution round the Sun, the artificial planet and the Earth may reach a point where the shortest distance between them will be of an order of one million kilometers.

The Last Stage of the Space Rocket and the Container With Scientific Equipment

The last stage of the space rocket is a controlled rocket connected by an adapter to the preceding stage.

Control of the rocket is effected by an automatic system which stabilizes the attitude of the rocket in a specified trajectory and ensures the calculated velocity at the end of the engine's operation. The last stage of the space rocket after fuel consumption weighs 1,472 kilograms.

In addition to the devices ensuring normal flight of the last stage of the rocket, its body contains a hermetically sealed, jettisonable container with scientific and radio engineering instruments; two transmitters with antennas operating on frequencies of 19.997-megacycles and 19.995 megacycles; a cosmic ray counter; a radio system, with the help of which, the flight path of the space rocket is determined and its future movement is predicted; and equipment for forming an artificial sodium comet.

The container is housed in the upper part of the last stage of the space rocket and is protected from heating, when the rocket passes through the dense layers of the atmosphere by a jettisonable cone.

The container consists of two spherical thin half-shells, hermetically joined together by frames with a sealer made from special rubber. Four rods of the antennas of the 186.3 megacycles transmitter are placed on one of the half-shells of the container. These antenna are fastened on the body symmetrically in relation to the hollow aluminium spike, at the end of which is an instrument for measuring the Earth's magnetic field and detecting the magnetic field of the Moon. Until the protective cone is discarded, the antenna are folded and fastened to the magnetometer spike. After the protective cone is jettisoned, the antenna open up. Located on the same half-shell are two proton traps for detecting the gas component of interplanetary matter and two piezo-electric pickups for the study of meteoric particles.

The half-shells of the container are made of a special aluminium-magnesium alloy. An instrument rack of tubular design, made of a magnesium alloy, is fastened on the frame of the lower half shell and the instruments of the container are placed on it.

The container houses the following instruments:

1. Equipment for radio control of the rocket's flight path, consisting of a transmitter operating on a frequency of 183.6 megacycles and a pack of receivers.

2. A radio transmitter operating on a frequency of 19.993 megacycles.

3. A telemetering box designed for transmitting by radio systems to the Earth data of scientific measurements and also data on the temperature and pressure in the container..

4. Instruments for the study of the gas component of interplanetary matter and the corpuscular radiation of the Sun.

5. Instruments for measuring the Earth's magnetic field and detecting the magnetic field of the Moon.

6. Instruments for the study of micrometeorites.

7. Instruments for the registration of heavy nuclei in primary cosmic radiation.

8. Instruments for the registration of the intensity and variations of intensity of cosmic rays and for the registration of photons in cosmic radiation.

The radio instruments and scientific equipment of the container are powered by silver-zinc batteries and oxide-mercury batteries placed on the instrument rack of the container.

The container is filled with gas at a pressure of 1.3 atmospheres. The design of the container ensures a high degree of hermeticity within it. The temperature of the gas in the container is maintained within the set limits (about 20° centigrade). The above temperature regime is ensured by imparting through special treatment to the container's shell specific coefficients of reflectance and emissivity. In addition, a ventilator for the forced circulation of gas is installed in the container. The gas circulating in the container draws off the heat from the instruments and passes it on to the shell, which serves as a sort of radiator.

The separation of the container from the last stage of the space rocket takes place after the engine of the last stage ceases operation.

The separation of the container is necessary to ensure the heat regime of the container. The point is that the container houses instruments which emit a large quantity of heat. The heat regime, as indicated above, is ensured by maintaining a specific balance between the heat radiated by the shell of the container and the heat received by the shell from the Sun.

The separation of the container ensures the normal operating regime of the antennas of the container and the instruments for measuring the Earth's magnetic field and detecting the magnetic field of the Moon; magnetic influences of the metallic structure of the rocket on the readings of the magnetometer are eliminated as a result of the separation of the container.

The total weight of the scientific and measuring instruments with the container, together with the power supply located in the last stage of the space rocket, is 361.3 kg.

To mark the development in the Soviet Union of the first space rocket which became an artificial planet of the solar system, the rocket carries two pennants with the coat of arms of the Soviet Union. These pennants are placed in the container.

One pennant is in the shape of a thin metal ribbon. On one side of the ribbon is the inscription: "Union of Soviet Socialist Republics," the other has the coat of arms of the Soviet Union and the inscription: "January-1959-January." The inscriptions are made by a special photochemical method ensuring their long preservation.

The second pennant is of a spherical form symbolizing the artificial planet. The surface of the sphere is covered with pentagon-shaped elements of special stainless steel. On one side of the pentagon-shaped element is the inscription: "USSR, January 1959," and on the other the coat of arms of the Soviet Union and the inscription "USSR."

Network of Measuring Equipment

To observe the flight of the space rocket, to measure its orbital parameters and receive scientific readings from aboard the space rocket, a large network of measuring equipment located over the entire territory of the Soviet Union was used.

Approved For Release 1999/09/08 : CIA-RDP82-00141R000200520001-5

This network comprised a group of automated radar equipment designed for accurate determination of elements of the initial section of the orbit; a group of radio telemetry stations for recording scientific information from aboard the space rocket; a radio system of control over the elements of the rocket's trajectory at great distance from the Earth; radio stations used to receive the signals on frequencies of 19.997, 19.995, and 19.993 megacycles; and optical means for observing and photographing the artificial comet.

Coordination between all the measuring instruments and tying in of the measurements with astronomical time was carried out by a special apparatus of uniform time and a radio communications system.

Processing of measurement data on the trajectory received from the local stations, a determination of the orbital elements, and the issuing of the coordinates to the measuring instruments was carried out by a coordinating-computing center using electronic computers.

Automated radar stations were used effectively to determine the initial conditions of the space rocket's movement and to issue a long-range forecast on the movement of the rocket and the exact coordinates to all measurement and observation stations. The measurements obtained by these stations were converted into a binary code, reduced to mean values, tied to astronomical time within several milliseconds, and automatically issued into lines of communication by means of special computing devices.

To avoid possible errors in measurements data when transmitting them over communication links, measurement information was coded. Use of the code made it possible to find and correct a mistake in a number being transmitted and to find and reject numbers containing two errors.

The measurement information thus converted was sent to the coordinating-computing center. Here, the measurement data was automatically put on punch cards by input devices on which electronic computers conducted combined processing of the results of measurements and computation of the orbit. On the basis of the use of a large number of trajectory measurements as a result of solution of the boundary value problem by the method of least squares, the initial conditions of the space rocket's movement were determined. Then a system of differential equations describing the mutual motion of the rocket, the Moon, the Earth, and the Sun was integrated.

Ground telemetry stations received scientific information from on board the space rocket and recorded it on photographic film and magnetic tapes. To ensure a great reception range of radio signals, highly sensitive receivers and special antennas with large effective areas were used.

The radio receiving stations, tuned to 19.997, 19.995, and 19.993 megacycles received radio signals from the space rocket and recorded these signals on magnetic tape. During this process, the field strength was measured, and a number of other measurements were taken which made it possible to conduct ionospheric investigations.

By changing the mode of keying of the 19.997 and 19.995 megacycles transmitter, data on cosmic rays were transmitted. Basic scientific information was transmitted on the 19.993 megacycles transmitter by changing the length of the interval between telegraph transmissions.

An artificial sodium comet was used for optical observations of the space rocket from the Earth with a view to confirming the fact of its passage through a given section of its trajectory. The artificial comet was formed at 0357, Moscow time, on 3 January, at a distance of 113,000 kilometers from the Earth. Observation of the artificial comet was possible from the areas of Central Asia, the Caucasus, Near East, Africa, and India. The artificial comet was photographed by a specially designed optical apparatus installed at southern astronomical observatories of the Soviet Union. Light filters, sensitive to the spectrum line of sodium, were used to increase the contrast of photographs. To increase the sensitivity of photographic equipment, a number of installations were supplied with electron-optical converters.

Despite the unfavorable weather conditions in most areas where optical equipment conducting observations of the space rocket was located, several photographs of the sodium comet were obtained.

The control of the orbit of the space rocket up to distances of 400,000 to 500,000 kilometers and measurements of the elements of its trajectory were carried out by a special radio system operating on a frequency of 183.6 megacycles.

Measurement data were automatically brought out and recorded in digital code on special devices at strictly definite moments of time.

At the same time as the readings of the radio system were taken, these data were efficiently channeled to the coordinating computing center. Combined processing of the measurements, together with the measurements obtained by the radar system, made it possible to specify the elements of the space rocket's orbit and directly control the rocket's movement in space.

Using powerful ground transmitters and highly sensitive receiving equipment ensured a reliable control over the space rocket's trajectory up to distances of the order of 500,000 kilometers.

The above-mentioned network of measuring equipment made it possible to obtain valuable data and to reliably control and forecast the rocket's movement in outer space.

Abundant material of trajectory changes obtained during the flight of the first Soviet space rocket and the experience of automatic processing of the trajectory changes by electronic computers will be of great importance in launchings of subsequent space rockets.

Scientific Investigations

Cosmic Ray Study

One of the main objectives of the scientific investigations conducted by means of the Soviet space rocket is the study of cosmic rays.

The composition and properties of cosmic radiation at great distances from the Earth are determined by the conditions of origination of the cosmic rays and the structure of interplanetary space. So far, information about cosmic rays was obtained by measuring them near the Earth. But, by virtue of the action of a whole series of processes, the composition and properties of cosmic radiation near the Earth sharply differ from what is characteristic of the "virginal" cosmic rays themselves. The cosmic rays we observe from the Earth's surface little resemble the particles that come to us from outer space.

When high-altitude rockets and, especially, Earth satellites are used, there is already no longer any essential amount of matter between the cosmic rays, as they come from outer space, and the measuring instrument. However, the Earth is circled by a magnetic field which partially reflects back the cosmic rays. On the other hand, this same magnetic field creates a sort of trap for the cosmic rays. Once it is in this trap, a cosmic ray particle wanders there for quite a long time. As a result, a large number of cosmic ray particles accumulate near the Earth.

While the device measuring cosmic radiation is within the sphere of influence of the Earth's magnetic field, the results of measurement will not enable us to study cosmic rays coming from the Universe. We know that at altitudes of 1,000 kilometers, only a negligible fraction of these particles -- only about 0.1 percent -- come directly from outer space. The remaining 99.9 percent appear, apparently, through the decay of the neutrons emitted by the Earth, or rather by the upper layers of its atmosphere. In turn, these neutrons are produced by the cosmic rays bombarding the Earth.

Only when we place the instrument not only outside the Earth's atmosphere but also outside the Earth's magnetic field, shall we be able to throw light on the nature and origin of cosmic rays.

The Soviet space rocket has various instruments on board making it possible to study from every angle the composition of cosmic rays in interplanetary space.

Cosmic radiation intensity was determined by means of two counters of charged particles. The compositon of cosmic rays was investigated by means of two crystal-controlled photomultipliers.

To this end the following were measured:

1. The energy flux of cosmic radiation in a wide range of energies.

2. The number of photons with energies of more than 50,000 electron volts (hard x-rays).

3. The number of photons with energies of more than 500,000 electron volts (gamma-rays).

4. The number of particles capable of passing through a crystal of sodium iodide (the energy of these particles is greater than 5 million electron volts).

5. The total ionization produced in the crystal by all types of radiation.

The counters of charged particles sent impulses to special so-called scaling circuits. By means of these circuits, it was possible to radio a signal when a specific number of particles had been counted.

The crystal-controlled photomultipliers recorded the flashes of light produced in the crystals when cosmic ray particles passed through them. The value of the impulse at the photomultiplier output is, within known limits,

Approved For Release 1999/09/08 : CIA-RDP82-00141R000200520001-5

directly proportional to the amount of light radiated inside the crystal at the moment of passage of cosmic ray particles within the crystal. The last value, in turn, is directly proportional to the energy expended by a cosmic ray particle on ionization in the crystal. By singling out those impulses whose value is greater than a specific level we can study the composition of cosmic radiation. The most sensitive system records all cases when the energy released in the crystal is more than 50,000 electron volts. However, in the case of such energies, the penetrating power of the particles is very small. In these circumstances, it is X-rays that will be mainly recorded.

The counting of the number of impulses is done by means of similar scaling circuits which were used to count the number of charged particles.

In a similar way, there are singled out the impulses whose value corresponds to a release of energy inside the crystal of more than 500,000 electron volts. Under these conditions, mainly gamma-rays are recorded.

By singling out impulses of a still greater value -- corresponding to the release of energies of more than 5 million electron volts -- there are recorded cases when cosmic ray particles possessing great energies pass through the crystals. It must be noted that the charged particles in the cosmic rays that move, in practice, with the same speed as light, will go through the crystal. In the majority of cases, the energy released in the crystal will be approximately equal to 20 million electron volts.

In addition to the measurement of the number of impulses, the total ionization produced in the crystal by all types of radiation is determined. A circuit consisting of a neon bulb, a capacitor, and resistors has been made for this purpose. This circuit makes it possible, by measuring the number of times the neon bulb burns, to determine the total current flowing through the photomultiplier and, thereby, to measure the total ionization produced in the crystal.

The investigations conducted by the space rocket permit determining the composition of cosmic rays in interplanetary space.

Study of Gaseous Component of Interplanetary Matter and Corpuscular Radiation of the Sun

Until recently, it was supposed that the concentration of gas in interplanetary space is fairly low and contains several particles per cubic centimeter. Yet certain astrophysical observations conducted in recent years challenged this viewpoint.

The pressure of solar rays on the particles of the upper layers of the Earth's atmosphere creates a peculiar "gaseous tail" of the Earth which is always directed away from the Sun. Its luminescence, which is projected on the stellar background of the nocturnal sky as counterglow is called Zodiacal light. In 1953, the results of observations of the polarization of Zodiacal light were published, which led several scientists to infer that from 600 to 1,000 free electrons are contained in a cubic centimeter of interplanetary space. If so, and inasmuch as the medium is electrically neutral on the whole, it should contain positively charged particles of the same concentration. With certain assumptions made from the polarization measurements, a dependence of electron concentration in interplanetary space on the distance to the Sun was deduced and, consequently, the density of the gas which should be completely or almost completely ionized. The density of interplanetary gas evidently decreases as distance to the Sun grows.

Another experimental factor in favor of the existence of interplanetary gas with densities in a range of 1,000 particles per cubic centimeter is the occurrence of so-called "whistling atmospherics," low-frequency electromagnetic oscillations caused by atmospheric electric charges. To account for the distribution of these electromagnetic oscillations from the place of their origin to the place where they are observed, it has to be assumed that they are distributed along the lines for force of the Earth's magnetic field at distances of eight to ten Earth radii, i.e., of an order of 50,000 to 65,000 kilometers, from the surface of the Earth in a medium with an electron concentration of an order of 1,000 electrons per cubic centimeter.

Yet, the inferences concerning the existence of such a dense gaseous medium in interplanetary space are not beyond argument. Thus, a number of scientists point to the fact that the polarization of Zodiacal light may be caused not by free electrons but by interplanetary dust. Assumptions have been put forth that gas in interplanetary space is present only in the shape of so-called corpuscular fluxes, i.e., flows of ionized gas ejected from the surface of the Sun and moving with velocities of 1,000 to 3,000 kilometers per second.

Apparently, the present state of astrophysics being what it is, the problem of the nature and concentration of interplanetary gas cannot be solved by observations conducted from the surface of the Earth. This problem -- very important for throwing light on the processes of gas exchange between the interplanetary medium and the upper layers of the Earth's atmosphere and for studying the conditions of distribution of the Sun's corpuscular radiation -- may be solved by instruments installed in rockets moving directly in outer space.

The purpose of the instruments of the study of the gas component of interplanetary matter and the corpuscular radiation of the Sun, installed on the Soviet space rocket, is to conduct the first stage of such investigations -- an attempt at direct detection of stationary gas and corpuscular fluxes in interplanetary space between the Earth and the Moon and the rough estimate of the concentration of charged particles in this area. In preparing the experiment on the basis of data available at present, scientists took as most probable the following two models of interplanetary gas medium:

1. There is a stationary gas medium, consisting mainly of ionized hydrogen (i.e, of electrons and protons -- hydrogen nuclei) with an electron temperature of 5,000-10,000° Kelvin (close to ion temperature). Corpuscular fluxes with a velocity of 1,000-3,000 kilometers per second and a concentration of particles of one to ten per centimeters pass through this medium at times.

2. There are only sporadic corpuscular fluxes, consisting of electrons and protons with velocities of 1,000-3,000 kilometers per second which at times, reach a maximum concentration of 1,000 particles per cubic centimeters.

The experiment is conducted with the help of proton traps. Each proton trap consists of a system of three concentrically placed semispherical electrodes with radii of 16 milometers, 22.5 milometers, and 20 milometers. The two outward eletrodes are made of thin metal netting, and the third is solid and serves as the proton collector. The electric potentials of the electrodes relative to the body of the container are such that the electric fields formed between the electrodes of the trap should ensure both the full collection of all protons and the ejection of electrons landing in the trap from stationary gas and also the suppression of the stream of photons in the collector arising under the influence of ultraviolet radiation of the Sun and other radiations acting on the collector.

The separation of the proton flux, created in the traps by stationary ionized gas and corpuscular streams (if they exist jointly), is effected by the simultaneous use of four proton traps. They differ from each other in that a positive potential, equal to 15 volts relative to the shell of the container, is created on the shell (outer nets) of two of the traps. This impeding potential prevents protons of the stationary gas (which have an energy of an order of one electron volt) from landing in the trap, but it cannot prevent corpuscular streams of much higher energy from landing in the proton collector. The two other traps must register the total proton flux created both by the stationary and the corpuscular protons. The outer net of one of them is under a potential of the shell of the container and the other has a negative potential equal to 10 volts relative to the same shell.

The currents in the circuits of the collectors after amplification are registered with the help of a radiotelemetry system.

Investigation of Meteor Particles

Apart from the planets and their satellites, asteroids, and comets, the solar system has a large number of small solid particles. They move, in relation to the Earth, at speeds, ranging between 12 and 72 kilometers per second, and, taken together, are called the meteor substance.

Thus far, the main information we have received about the meteor substance plunging into the Earth's atmosphere from interplanetary space has been obtained by astronomical methods and also by radar.

On plunging into the Earth's atmosphere with tremendous speeds, relatively large meteor bodies burn out inside it. In doing so, they produce a glare which can be seen both by aided and unaided vision. Radar tracks the tinier particles according to the trail of charged particles -- electrons and ions -- that are formed during the flight of a meteor body.

Through these investigations, we have obtained data about the densities of meteor bodies near the Earth and about their velocities and masses, from 10^{-4} grams and upwards.

Data about the tiny and most numerous particles, with diameters of several microns, are obtained by observing dispersed sunlight only on a tremendous cluster of such particles. An individual micrometeor particle can be studied only by means of instruments carried by artificial Earth satellites or high-altitude and space rockets.

The study of the meteor substance is of great scientific value for geophysics and astronomy and for tackling the problems of the evolution and origin of planetary systems.

In view of rocketry development and the beginning of the era of space travel, ushered in by the first Soviet space rocket, the study of meteor substances assumes great interest purely from a practical angle. This interest is aroused by the need to determine the danger meteors may present to space rockets and artificial Earth satellites during long flights.

When they hit a rocket, meteor bodies can affect it in different ways: destroy it or, by piercing the shell, make the cabin no longer air-tight. The micrometeor particles, acting on the shell of the racket for a long time, may cause changes in the nature of its surface. From its original state of transparency, the surface of optical devices may become opaque, due to collision with micrometeor bodies.

We know that the probability of a collision between a space rocket and meteor particles that could damage it is slight. However, it exists. It is important that it be properly evaluated.

To study the meteor substance in interplanetary space, the space rocket's instrument-housing container has two ballistic piezoelectric pick-ups of ammonium phosphate registering the hits of micrometeor particles. These pickups convert the mechanical energy of an impinging particle into electric energy, the value of which depends on the mass and velocity of the impinging particle. Accordingly, the number of impulses is equal to the number of particles that hit the pickups' exposed surface.

The electrical impulses from the pickup, which are short damped oscillations are fed to the input of an amplifier converter which classes them in three ranges according to their amplitude, and counts the number of impulses in each amplitude range.

Magnetic Measurements

The successes of Soviet rocketry opens up great possibilities for geophysicists. Space rockets enable them to make direct measurements of magnetic fields of planets by special magnetometers or to detect fields of planets, thanks to their possible influence on the intensity of cosmic radiation directly in the space surrounding the planet.

The flight of the Soviet space rocket equipped with a magnetometer in the direction of the Moon is the first such experiment.

Besides studies of magnetic fields of cosmic bodies, of great importance is the question of the intensity of the magnetic field in outer space in general. The intensity of the geomagnetic field at a distance of 60 Earth radii (the distance to the Moon's orbit) practically equals zero. There is every basis for assuming that the magnetic moment of the Moon is small. In the case of uniform magnetization the magnetic field on the Moon should diminish according to the law of the cube of the distance from its centre. In the case of nonuniform magnetization, the intensity of the Moon's field will diminish still faster. Consequently, it can be reliably detected only in close proximity to the Moon.

What is the intensity of the field in the space within the Moon's orbit at a sufficient distance from the Earth and the Moon?

Is it determined by values calculated from the magnetic potential of the Earth or does it depend on other causes as well? The geomagnetic field was measured by Soviet Sputnik III within a range of altitudes of 230-1,800 kilometers, i.e., up to one third of the radius of the Earth. The relative contribution of the possible nonpotential part of the permanent magnetic fields, will be greater at a distance of several radii of the Earth, where the intensity of its field is already sufficiently small. At a distance of five radii, the Earth's field should be approximately 400 gamma (one gamma equals 10^{-5} oersted).

The placing of a magnetometer on board the rocket flying in the direction of the Moon pursues the following aims:

1. To measure the geomagnetic field and the possible fields of flux systems in the space within the orbit of the Moon.

2. To detect the magnetic field on the Moon.

The question of whether the planets of the solar system and their satellites are magnetized like the Earth is an important problem of astronomy and geophysics.

A statistical treatment of a large number of observations conducted by magnetologists to discover the magnetic fields of the planets and the Moon by their possible effect on the configuration of corpuscular fluxes ejected by the Sun has yielded no definite results.

An attempt to establish a general connection between the mechanical moments of cosmic bodies, known for most planets of the solar system, and their possible magnetic moments, was not borne out experimentally in a number of ground experiments which followed this hypothesis.

At present, the model of regular currents flowing in the molten-conductive Earth's core and causing its basic magnetic field is used most frequently in various hypotheses of the origin of the Earth's magnetic field. The Earth's revolution around its axis is drawn on to account for special features of the Earth's field.

Thus, according to this hypothesis, the existence of a molten-conductive core is absolutely indispensable for a magnetic field in general.

We know but little about the physical state of the Moon's inner layers. Until recently it was assumed, from the shape of the Moon's surface, that even if the mountains and craters were of volcanic origin, the Moon's volcanic activity had long ceased and it is unlikely that the Moon has a liquid core. From this point of view, it ought to be assumed that the Moon has no magnetic field, if the hypothesis of the origin of the Earth's magnetic field is correct. If the volcanic activity in the Moon continues, then, the possibility of existence of the Moon's heterogeneous magnetism and even general homogeneous magnetism, is not excluded.

The sensitivity, range of measurements of the magnetometer, and its operating program for the Soviet space rocket had been chosen to solve the tasks mentioned above. Since the orientation of the pickups with respect to the magnetic field to be measured constantly changes due to the revolution of the container and the revolution of the Earth, a three-component magnetometer of complete vector with magnetic-saturation pickups was used for the experiment. Three mutually perpendicular sensitive pickups of the magnetometer were fixed immovably with respect to the body of the container on a special nonmagnetic support more than a meter long. Yet the effect of the magnetic parts of the container's equipment is 50 to 100 gammas, depending on the orientation of the gauge. Sufficiently accurate results in measuring the Earth's magnetic field may be obtained within distances of four to five Earth radii.

The scientific apparatus installed aboard the space rocket functioned normally. A great number of recordings of measurements results were obtained. They are now being analyzed. A preliminary analysis shows that the results of the investigations are of great scientific importance. These results will be published as the analysis of observations proceeds.

The Artificial Sodium Comet and the Apparatus for Making It

The artificial sodium comet is a cloud formed of the vapours of sodium in an atomic state. It is discharged into outer space by the rocket at a specified moment. The sodium cloud shines because of resonance fluorescence. The substance of this phenomenon lies in the fact that the atoms of sodium disperse sunlight in a narrow range of frequencies within the yellow band of the solar spectrum.

The light dispersed by the sodium cloud is monochromatic. This makes it possible to weaken largely the background of the sky when observing the cloud through special light filters.

According to calculations, the brilliance of the sodium cloud containing one kilogram of sodium and discharged 113,000 kilometers away from the Earth should be approximately equal to the sixth star magnitude. This is on the borderline of unaided vision. For the sake of comparison, it should be noted that the brilliance of the space rocket itself, at this distance away, is equal to the 14th star magnitude.

Consequently, the creation of the artificial sodium comet enables us here on Earth to observe optically a specific point in the trajectory of the space rocket's flight.

The sodium comet can be observed only at night. It is this circumstance that determines the time and place of the formation of the sodium cloud during the space rocket's flight. The time for the formation of the artificial comet was chosen so that it could be seen by the largest possible number of observation stations in the Soviet Union.

A special apparatus was used to form the artificial sodium comet. It was installed on the final stage of the space rocket. Its main unit is a sodium evaporator. This evaporator is designed so as to evaporate one kilogram of sodium within 5 to 7 seconds and to discharge the sodium cloud under conditions of weightlessness and the vacuum of outer space.

The signal switching on the evaporator at the exact moment of time is given by a small electronic device, the main unit of which is a quartz clock.

The successful launching of the Soviet space rocket in the direction of the Moon, and the creation of the first artificial planet are an outstanding achievement for Soviet science and engineering.

Approved For Release 1999/09/08 : CIA-RDP82-00141R000200520001-5

The day is already not far off, when space ships will fly to the farthermost points of the solar system along routes in space pioneered by the launching of the Soviet rocket. Man has entered an era of the direct invasion of the universe.

[Eight pictures and diagrams accompany the article. The captions read as follows:

Page 1 -- "Penants" on board the cosmic rocket
Above -- The spherical "penant" symbolizing the artificial planet
Below -- "Penant"-strip (showing front and back)

Page 3 -- Course of Cosmic Rocket on Surface of the Earth
Numbers on the drawing correspond to successive locations of the rocket projected on the surface of the Earth: (1) 0300 hours 3 January, 100,000 kilometers from the Earth; (2) formation of the artificial comet; (3) 0600 hours, 137,000 kilometers; (4) 1300 hours, 209,000 kilometers; (5) 1900 hours, 265,000 kilometers; (6) 2100 hours, 284,000 kilometers; (7) 0559 hours, 4 January, 370,000 kilometers -- the moment of closest approach to the Moon; (8) 1200 hours, 422,000 kilometers; (9) 2200 hours, 510,000 kilometers; (10) 1000 hours 5 January, 597,000 kilometers.

Pentagonal elements of the spherical "penant"

Trajectory of the rocket's approach to the Moon

Path of rocket towards the Moon on a map of the star sky

Calculated orbit of the artificial planet relative to the Sun

Page 4 -- Container with scientific and measuring apparatus (on an assembly cart).

Instrument frame of container with apparatus and power package (on assembly cart)] ("The Soviet Space Rocket," Moscow, Pravda, 12 Jan 59)

Comments of Leading Soviet Scientists on Space Rocket

Statements by leading Soviet scientists have received wide coverage in the Soviet press. The underlying theme appearing in these is that once again the superiority of the socialist order to the capitalistic has been demonstrated. References contrasting Soviet successes with US failures are numerous.

Prominent among those quoted are A. N. Nesmeyanov, president of the Academy of Sciences; A. Topchiyev, vice-president; M. G. Kroshkin, Candidate of Physicomathematical Sciences, scientific secretary for the Working Group on Rockets and Satellites of the Soviet Committee for International Geophysical Cooperation; and Prof Dr. Boris Kukarkin.

A few of these comments follow.

Academician A. Topchiyev, vice-president of the Academy of Sciences USSR, says that the rocket is not expected to return. Its speed is such that it could not be captured by the gravitational pull of the Moon and that it would continue outward into cosmic space within the bounds of the solar system. ("Notable Start of the 7-Year Plan," by Academician A. Topchiyev; Moscow, Pravda, 5 Jan 59, p 4)

Prof Dr Boris Kukarkin, director of the State Astronomical Institute imeni P. K. Shternberg, Moscow State University imeni M. V. Lomonosov, and member of the Interdepartmental Commission on Interplanetary Communications of the Astronomical Council, Academy of Sciences USSR, says the hitting of the Moon is fully possible, but this was not the aim of the first Soviet rocket launched in its direction.

The rocket passed several thousand kilometers from the surface of the Moon and became the first new small planet of our solar system created by man. The possibility that the rocket will again encounter the Earth near the spot it began its flight, sometime in the future, is not excluded.

The flight of the rocket near the Moon will aid in solving many interesting problems concerning it, which will be of great value for future cosmic flights and for understanding the processes of the development of planets.

Looking into the future, Kukarkin says that the years to come will bring the Soviets new successes in the investigation of interplanetary space and after that, interstellar space. It is positive that the first celestial body to be studied will be the Moon. The investigation of the Moon as an independent planetary body of our solar system will play an important role in understanding the processes of the formation and development of planets and will serve as a school for more complex trips on other planets.

Kukarkin continues, saying that the idea proposed by A. A. Yakovkin, director of the Main Astronomical Observatory of the Academy of Sciences Ukranian SSR is not without interest. Yakovkin has proposed the idea of creating an artificial satellite of the Moon. A velocity not in excess of one to 2 kilometers per second would be sufficient for this purpose. Such a satellite would give a more precise determination of the Moon's mass and, connected with this, the possibility of more accurately determining the distance of the Earth from the Sun. The location of such a satellite could be observed in its moments of brightness with considerably more accuracy than the Moon itself. ("Study of the Moon With the Aid of Cosmic Rockets," by Prof B. Kukarkin; Moscow, Pravda, 5 Jan 59, p 6)

A. Mikhaylov, director of the Main Astronomical Observatory, Academy of Sciences USSR, says that the Soviet cosmic rocket was launched under adverse conditions during the last quarter, when the Moon was near the celestial equator. The most suitable time for such a launching is at the time of the new moon. But then it would be impossible to conduct optical observations of the rocket near the Moon. The Moon has now crossed into the southern hemisphere and visual and photographic observations can only be conducted by observatories located in the southern part of the Soviet Union. ("The Pride of Soviet Scientists," by A. Mikhaylov; Moscow, Pravda, 4 Jan 59, p 5)

Ye. Kharadze, director of the Abastuman Astrophysical Observatory, Academy of Sciences Georgian SSR, says that more than 20 photographs of that region of the sky where the sodium cloud was to be created by the rocket were made by means of special apparatus. The obtained results give basis to assume that the moment of the flare was captured. ("Revealing the Secrets of the Universe," by Ye. Kharadze; Moscow, Pravda, 4 Jan 59, p 5)

Academician V. Ambartsumyan, president of the Academy of Sciences, Armenian SSR, says that the success of the Soviet cosmic rocket indicates that the time is not far off when man himself will stand on the surface of the Moon and then on other planets. ("Triumph of Soviet Science and Technology," by V. Ambartsumyan; Moscow, Pravda, 5 Jan 59, p 4)

Academician V. Fesenkov, director of the Astrophysics Institute, Academy of Sciences Kazakh SSR, hails the launching of the Soviet space rocket as a new indication of the mastering of space by man. He reviews some of the problems for which the rocket is instrumented. Of particular importance to himself, he says, is the direct measurement of the gaseous composition of the medium in interplanetary space, which, as yet, is not affected by the Earth's atmosphere. Observations by the satellites revealed that the atmosphere extended much farther from Earth than previously believed. Up to now, many observers, on the basis of observations of Zodiacal light in the plane of the ecliptic, held that each cubic centimeter of space in the distance from the Earth to the Sun contained about 800 protons. His own observations, conducted in Egypt in 1957, showed that the proton content of interplanetary gases was very small, but the content of fine dust --- the product of the disintegration of asteroids and, in particular, comets --- was very large. Direct measurements of the composition of the interplanetary medium which will be realized by the cosmic rocket will at once solve this problem connected with the presence of the corpuscular radiation of the Sun and with any principally important pecularities of the planetary system.

Other problems will undoubtedly be solved in the future. The other side of the Moon will be viewed with television apparatus, it will be possible to investigate the transition of the solar atmosphere into adjacent interplanetary space and to understand better the mechanism of forces acting on the Sun, to observe the surface of the planets and the Sun in considerably greater detail than ever before, and later, visits to other cosmic bodies of our planetary system can begin.

"If we limit ourselves to the solar system and do not dream of traveling to remote stars, then it is possible to consider that with respect to the velocities achieved, the problem of mastering interplanetary space has already been almost solved. In the future, it will be necessary to concentrate our main attention on making a rocket suitable for habitation over a long period of time and also to ensure the possibility of its control and landing." (First Cosmic Voyage," V. Fesenkov; Moscow, Pravda, 4 Jan 59)

L. S. Galkin, scientific secretary, Crimean Astrophysical Observatory Academy of Sciences USSR, reveals that special apparatus was prepared for conducting observations of the Soviet rocket. The observatory's very powerful (1:1.4) camera was considered especially suitable for photographing the sodium cloud. It is proposed to make use of motion pictures so as not to fail in recording the moment when the rocket is in the vicinity of the Moon. ("New Stage in the Conquest of the Cosmos"; Moscow, Izvestiya, 4 Jan 59, p 5)

Sodium Cloud Photographed by Alma Ata Observatory

The sodium cloud created by the Soviet cosmic rocket was successfully captured on film by the Alma Ata High Mountain Observatory of the Institute of Astrophysics, Kazakh SSR. Prints were immediately flown to Moscow. ("Artificial Comet Photographed"; Moscow, Izvestiya, 6 Jan 59, p 3)

Soviet Film Dedicated to Launching of Cosmic Rocket

A new motion picture issued by the Central Studio of Documentary Films and the Moscow Studio of Popular Science Films, "Great Victory of Mankind," is dedicated to the launching of the Soviet cosmic rocket. The film opens with representation of the tremendous sensation which the news of the launching caused throughout the world.

The film shows how the first rockets were launched in the Soviet Union as far back as the lifetime of the great K. E. Tsiolkovskiy.

The viewer is transported to the Arctic where Soviet Geophysists are conducting scientific investigations. For the first time, pictures of the launching of meteorological rockets with which the upper layers of the atmosphere are investigated are shown. The viewer sees how these flying laboratories are readied and launched from high, welded steel towers.

The film ends with the showing of N. S. Khrushchev's appearance in Minsk on 3 January, where he spoke on the importance of the launching of the Soviet cosmic rocket.

A picture taken from the film which appears with the article shows a research rocket at the launching tower. ("Great Victory of Mankind"; Moscow, Pravda, 15 Jan 59, p 4)

Use of Light Flashes for Determining Satellite Location in Space

The following is a full translation of an article by G. A. Leykin, member of the Interdepartmental Commission for Interplanetary Travel Under The Astronomical Council, Academy of Sciences USSR, entitled "The Use of Light Flashes for Determining the Locations of Artificial Earth Satellites." Leykin has also written an article, "Probe for Measuring Density and Temperature While Moving With Supersonic Speed in a Strongly Rarefied Medium," (See Soviet Bloc IGY Information, No. 31, 12 Sep 58) which has application for the orientation of rockets and satellites in space.

1. Indications concerning the advantage of using light flashes for determining the locations of artificial earth satellites and rockets and communication with them available in literature (Scientific Uses of Earth Satellites, D. E. Hudson, 1956, p 39) are usually based only on the affirmation that flashes give a considerable economy of energy in comparison with continuous sources of illumination. However, there is another factor which determines the advantageousness of the use of flashes.

2. In determining the locations in space of a satellite not equipped with a flashing light, it is most difficult to register the moment in which the satellite is at this or at any point. The error of one determination during visual observations can exceed 0.5 seconds because of individual or accidental error.

Breaks in trails of a satellite (F. L. Whipple and J. A. Hynek, Proc. J. R. E., 44, No. 6, p 760) produced by mechanical devices, rotating obturators fixed near the film or near the objective or louver-type shutters, are used in photographic observations for plotting time marks. The use of a mechanical device operating with sufficient accuracy requires the creation of the most complex and expensive mechanisms. In addition to this, inasmuch as the flow of light is not instantly interrupted, some uncertainty inevitably remains: placing the shutter near the objective results in a washed out appearance of the breaks in the trail near the gaps; by placing the rotating shutter near the film such washing out can be decreased, but then there appears the dependence of the length of the severing of the trail on the direction of the motion of the satellite in relation to the shutter opening. Finally, it is possible to propose still another design in an instrument for recording the moment of the passage of a satellite through a given point, a photocell in the focus of the objective registering only an extremely narrow band in the celestial sphere. However, even in this last case, if the difficulty connected with the necessity of recording extremely small and momentary changes of a flow of light were successfully eliminated the accuracy of determining the moment of time would still be limited, inasmuch as the cathode of the photocell would not be instantly illuminated (in the course of a certain time, its illumination must increase and then diminish).

The determination of the moment of passage by radio methods is hampered by the low accuracy of determining the location of the satellite in the celestial sphere.

3. The difficulty pointed out in 2 is lessened if a device giving flashes of light at fixed moments of time is installed on the satellite. In this case, it is sufficient to know approximately, the moment of the flash with the accuracy provided by the device on the satellite. Modern devices ["Vysokoskorostanaya Kinofotos'yemka v Nauke i Tekhnike" (High Speed Motion Picture Photographing in Science and Engineering), III, 1955, p 132; and, L. N. Korablev Novyye Primeneniya Lamp s Kholodnym Katodom v Impul'snoy Apparature (New Uses of Cold Cathode Lamps in Pulse Apparatus), M. 1956, p 161] have an accuracy of about 1 —0.01 percent of interval. For determining the locations of a satellite with an accuracy of 2-3 seconds of an arc, it is necessary to ensure an accuracy of the moments of the flashes down to one millisecond. The most promising source of light is, as indicated above [F. L. Whipple and J. A. Hynek, Proc. J, R, E,, 44, No 6, 1956, p 760] the pulse gas-discharge lamp, similar to those used in photography.

The duration of the flash of such a lamp can be reduced to several ten-thousandths of a second.

It should be noted, however, that the thermal regime of a satellite with sharp temperature fluctuations requires the development of special condensers which are little affected by changes in temperature and which at the same time have great capacity. Recording the moment of the flash can be conducted, for example, with the aid of "blinking" on the radio range, synchronized with the light flash. In this, it is extremely essential that the registration of the moment be done at an observatory having time service and not at a point conducting photographing. If the moment of one of the bright flashes is registered, the moments of the remaining flashes can be obtained by a simple calculation.

4. During photographic observations, it is expedient to have a special series of several flashes over each instrument conducting photographing. The duration of the series will be determined by the camera's field of view (5 degrees near astronomical cameras, and 20 degrees near aerial cameras). It is essential that in night observations for flashes, the usual astronomical cameras without any supplementary attachments be used. Sufficiently precise ephemerides are all that are necessary. It is obvious that it is most efficient to have flashes at a distance of 1/2 degree from each other, which make it comparatively easy to distinguish them in the photograph, and, at the same, time, this ensures sufficient accuracy in the intervals. The moment of one of the flashes of a series must be registered on Earth. ("Use of Light Flashes for Determining Locations of Artificial Earth Satellites," by G. A. Leykin; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 12, Dec 58, pp 1520-1521)

II. OCEANOGRAPHY

Severyanka in North Atlantic on Second Voyage

The Severyanka, Soviet scientific research submarine, entered the Bering Sea on 29 December on its second voyage. V. P. Zaytsev, director of the All-Union Scientific Research Institute of the Fish Economy and Oceanography (VNIRO) reported that the present voyage will last about 20 days.

The answers to several important problems must be obtained, said Zaytsev. Scientists aboard will conduct investigations of the water medium, the behavior of shoals of fish, and fishing operations with drift nets.

The scientific staff includes an ichthyologist, an engineer for fish catching, a biologist, a specialist for underwater surveys, and other scientific associates. The craft, when contacted by radio on 4 January by a member of the Pravda staff, reported its position as in the North Atlantic. The heading is north. Members of the expedition are conducting observations on the ocean and its life. All apparatus is working satisfactorily. ("Severyanka on Long Voyage," by V. Shapovalov, and V. Azhazha; Moscow, Pravda, 5 Jan 59, p 6)

III. ARCTIC AND ANTARCTIC

Observatory on Ostrov Kheysa

The northernmost scientific observatory in the world is on the Arctic island, Ostrov Kheysa, situated on the 81st parallel.

The station's laboratories and pavilions are equipped with modern instruments, and the Soviet scientists at this place carry out an extensive program of scientific observations. Special attention is given to the upper atmosphere by launching meteorological rockets and radiosondes. Auroras are being photographed on a continuous basis, and variations of the magnetic field are recorded. The results of observations are fixed on thousands of meters of motion-picture and photographic film and are entered in journals. The work of the observatory was highly praised at the 5th Assembly of the IGY Special Committee. -- V. Gerasimenko, chief of observatory on Ostrov Kheysa. ("Dark Night Over the Archipelago"; Moscow, Vodnyy Transport, 1 Jan 59)

Severnyy Polyus-6 Continues Operation

The ice floe on which the station Severnyy Polyus-6 is located has traveled a total of over 1,900 kilometers on a general course since the beginning of the drift. The station is now 330 kilometers from the North Pole.

The station staff has collected extensive material which is of great theoretical interest for the further study of many natural phenomena of the Central Arctic and for the improvement of navigation along the Northern Sea Route.

The ice island is now at a great distance from the mainland. The nearest islands are Severnaya Zemlya, a distance of 645 kilometers to the south, and Zemlya Frantsa Iosifa, a distance of 660 kilometers to the southwest.

In 1959, when the International Geophysical Cooperation continues, Soviet polar scientists will make valuable contributions to the further development of Soviet science. -- S. Serlapov, chief of station Severnyy Polyus-6. ("From Pole to Pole -- In the Central Arctic"; Moscow, Vodnyy Transport, 1 Jan 59)

Operation of Soviet Drift Stations

Two Soviet drift stations are now operating in the Central Arctic Basin under the program of the IGC-1959, Severnyy Polyus-6 and Severnyy Polyus-7. Observations are conducted at the stations in the fields of oceanography, meteorology, aerology, terrestrial magnetism, ionosphere, auroras, and marine geology.

The station Severnyy Polyus-6 was organized in the spring of 1956 by the Arctic and Antarctic Scientific Research Institute. It was established on a drifting ice island discovered by the pilot V. Maslennikov 330 kilometers north of Ostrov Vrangelya. The ice island represents a massive ice monolith of irregular, oval shape, with a total area of about 65 square kilometers and a thickness of 10-12 meters. The surface of the island is crossed by shallow valleys, along which numerous rivulets of melt water flow in the summer. The accumulating water forms small lakes in isolated, shallow depressions. The ice island is surrounded from all sides by hummocked pack ice.

The settlement on the ice island consists of seven prefabricated panel-type huts for the living quarters, the scientific laboratories, the dining room, and kitchen. In addition to scientific equipment, the station has a tractor and a truck.

The first staff to winter on the island consisted of 26 Soviet polar specialists, headed by K. Sychev, Candidate of Geographical Sciences. In April 1957, the second staff, under V. Driatskiy, Candidate of Geographical Sciences, took over. Since 9 April 1958, a new group of scientists, under S. Serlapov, Candidate of Geographical Sciences, has been working on the ice island.

During the 32 months which have passed since the organization of the station, the island has drifted from a point 74-24 N and 182-50 E to a point 87-14 N and 92-13 E. It has drifted over 1,900 kilometers in a general direction to the north-northwest, but the actual course, including all loops and detours, covered over 7,100 kilometers.

For a long time, the station drifted over a continental shelf, with average depths of 100-200 meters. In early February 1958, drifting about 270 kilometers north of Ostrov Genrietty, the ice island moved out over the continental slope and then continued to drift over great ocean depths, exceeding 2,000 meters.

In June 1958, the station passed over the submarine range named after M. Lomonosov. The least depth above this mountain range, 1,043 meters, was recorded on 4 June 1958 at a point 82-37 N and 142-09 E. The greatest change in depth measurements was noted on 16 June. In the morning of that day, the depth was 1,338 meters, and in the evening, it was 2,200 meters. The ice island had drifted into the western part of the Central Arctic Basin.

Severnyy Polyus-6 is the first Soviet station organized on a floating ice island. During the entire period of its drift, it has not been subjected to cracking or hummocking. A study of the ice structure of this island has confirmed the original assumption regarding its marine origin. The ice monolith, on which the station is located, was probably once a part of the old fast ice of the Canadian Arctic Archipelago.

Members of the station Severnyy Polyus-7 were landed by planes on drifting pack ice of the Arctic Ocean at the end of April 1957. This was about 1,200 kilometers north-northeast of Ostrov Vrangelya, at the spot where the drift station Severnyy Polyus-2 finished its drift in 1951. The ice field was 1,200 by 1,500 meters in size, and the ice was 3 to 6 meters thick.

Severnyy Polyus-7 has the same kind of equipment as Severnyy Polyus-6. During the first winter, 20 men, headed by V. Vedernikov, Candidate of Geographical Sciences, remained at the station. Since April 1958, the second staff, headed by N. Belov, Candidate of Geographical Sciences, has been working at the station.

During the first 5 months, the ice floe drifted in a general direction to the north-northwest. Then the course changed sharply to the south, and then to the east. Having described an irregular curve around the mathematical point of the North Pole, the ice floe reached its most eastern location, 87-35 N and 301-53 E, at the end of October 1958. After that, the direction of the drift changed sharply to the south-southwest. Now the ice floe is drifting in the direction of Grant Land.

During 20 months of its drift, the ice floe moved from a point 82-09 N and 195-30 E to a point 86-20 N and 297-09 E. It has drifted in a general direction for more than 1,000 kilometers, but the actual course, including detours, covered about 3,300 kilometers. Most of the time, the ice floe passed over great ocean depths of 2,000 to 4,000 meters. In July 1957, and during the past few months, the station passed over the Lomonosov Range and its spurs. Therefore, the depths were frequently reduced to 1,500-1,100 meters.

The ice floe of Severnyy Polyus-7 has often been subjected to heavy nipping and splitting, and has been greatly reduced in size.

The results of weather observations at the drift stations are transmitted eight times a day by radio to the Weather Service of the Main Administration of the Northern Sea Route and the Main Administration of the Hydrometeorological Service. These data are used for compiling weather forecasts for the Arctic and for the Soviet Union as a whole. The materials of weather and ice observations are also used by the Arctic and Antarctic Institute in preparing forecasts of ice conditions in the polar seas.

The large amount of oceanographic observations conducted at the stations has been expanded and provides information on the stratification and depth of the water masses in the Arctic Basin, the regime and drift of ice, and the relief and soil composition of the ocean bottom.

For the first time, geomagnetic research has helped to compile sufficiently reliable magnetic charts. These are of great scientific interest and practical value for ship and plane navigators.

On the evening of 21 December 1958, the weather was calm and almost windless. Suddenly, a heavy jolt was felt in the northeastern part of the ice floe, where the station Severnyy Polyus-7 is located, and a 3-5 meter wide crack was formed. The crack passed through the geologists' tent and the food storage place, and separated a field of 300 by 600 meters from the ice floe with the main camp of the station. The pavilion for ionospheric observations was located in the center of the separated ice field. During the next few days, the ice floe was subjected to heavy pressure and rows of hummocks were formed along the edges. The station staff worked with great determination and presence of mind and avoided the danger threatening the camp. In a short time, all the equipment which had been on the split-off part of the ice floe was transported to the camp. The scientific work continued according to plan.

Difficulties like these will not break the spirit and determination of the Soviet scientists. The daily reports from Severnyy Polyus-7 transmitted by station chief N. Belov invariably close with the words: "All is in order at the station." ("The Deeds of the Brave -- At the Drift Stations"; Moscow, Vodnyy Transport, 8 Jan 59)

Ob' Arrives in Antarctic

After a 2-day stop in the South African port of Capetown for refueling and replenishing of food and fresh-water supplies, the Ob' continued on its voyage. On 29 December, at 2310 hours Moscow time, the Ob' approached the edge of the fast ice, 5 miles north of the Soviet Antarctic station Mirnyy. The voyage from the Baltic to Antarctica was completed. The ship cut into the fast ice and began to move slowly toward Mirnyy. The fast ice is very heavy, in some places it is 2 meters thick.

The members of the Fourth Antarctic Expedition aboard the Ob' will replace the staffs at Mirnyy and the interior Soviet stations. ("The Ob' Has Arrived in Mirnyy"; Moscow, Vodnyy Transport, 1 Jan 59)

Members of Former Expeditions Return to Antarctic

Many of the expedition members aboard the Ob', which has just arrived at the Antarctic coast, have taken part in earlier Antarctic expeditions. For example, V. Shlyakhov, Candidate of Physicomathematical Sciences, chief of the aerometeorological detachment of the Fourth Antarctic Expedition, spent 12 months in Antarctica during 1957-1958 and then worked for 6 months on the Ob' during the exploratory voyage in the Indian, Pacific, and Atlantic oceans.

Other expedition members who have been in Antarctica repeatedly are D. Solov'yev, geologist; N. Baranov, aerologist; I. Korniyenko, radio operator; and many others. ("On the Ice Shores"; Moscow, Vodnyy Transport, 3 Jan 59)

* * *